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# Flora of Bokor National Park, Cambodia III: A New Species, *Garcinia bokorensis* (Clusiaceae)

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A new species, *Garcinia bokorensis* H. Toyama & Yahara (Clusiaceae), is described from Bokor National Park, Cambodia. We provide a description, illustration and photographs of the new species, and update the key to identify the species of *Garcinia* sect. *Oxycarpus* in Indochina.

Key words: Bokor National Park, Cambodia, Clusiaceae, *Garcinia*, new species

*Garcinia* L. (Clusiaceae) comprises about 260 species of usually dioecious small shrubs to medium-sized trees that are common components of lowland tropical forests worldwide (Stevens 2007). The genus exhibits a remarkable diversity of floral morphology, which is used for delimiting the genus and for constructing infrageneric classifications (Sweeney 2008). The latest monograph, published more than a century ago by Vesque (1893), classifies 180 species into 9 sections based on floral morphology. Among the sections Vesque (1893), sect. *Oxycarpus* is widely distributed in the Andaman Islands and from Southeast Asia to Fiji. It is distinguished from other sections by the tetramerous flowers and 4-angled stamens (Vesque 1893). In Indochina, eight species have been recorded in *Oxycarpus*: *Garcinia cochinchinensis* (Lour.) Choisy, *G. cowa* Roxb. ex DC., *G. delpyana* Pierre, *G. fusca* Pierre, *G. nigrolineata* Planch. ex T. Anderson, *G. oblongifolia* Champ. ex Benth., *G. oliveri* Pierre, and *G. schomburgkiana* Pierre (Pierre 1880, Pitard 1910, Gagnepain 1943, Hô 1999, Dy Phon 2000, Li *et al.* 2007, Newman *et al.* 2007).

Bokor National Park in Cambodia (Fig. 1) covers 1,400 km$^2$ and includes a sandstone plateau known as Elephant Mountains that rises sharply from sea level to an elevation of 1,079 m (Rundel *et al.* 2003). Mean annual rainfall is more than 5,000 mm known as one of the most humid places in Indochina. The park has a temperature of about 20°C that remains relatively constant throughout the year (Rundel *et al.* 2003). The floristic diversity of the area was studied by French botanists during the first half of the 20th century as a part of a floristic survey of Indochina (Gagnepain *et al.* 1907–1951). Subsequent botanical surveys were disrupted until termination of the Cambodian civil war in 1992. Beside the incomplete floristic survey, the vegetation of Mt. Bokor has deteriorated due to increased pressure from logging and resort development (Kowalczyk 2009). Evaluation of plant diversity is needed to develop conservation

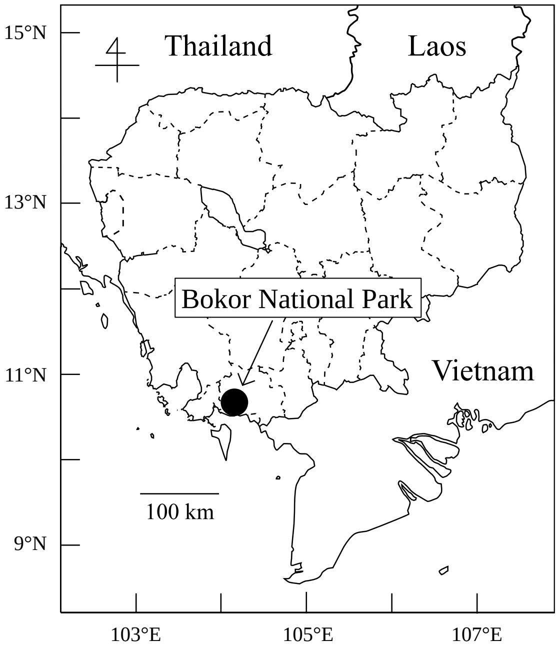

FIG. 1. Location of Bokor National Park, in Cambodia.

planning (Rundel 1999, Kosterin 2012).

In 2010–2013, we carried our field surveys to assess plant diversity in Bokor National Park. We collected ca. 3,100 specimens, including ca. 770 that we were able to identify and 13 new species (Tagane *et al.* 2015). We here describe another new species, *Garcinia bokorensis* H. Toyama & Yahara of sect. *Oxycarpus*, and provide a key for identification of the species of sect. *Oxycarpus* in Indochina. Specimens in the herbaria at BKF, KYO, TI, VNM and digital images of specimens on JSTOR Global Plants, Herbier National de Paris, Muséum National d'Histoire Naturelle (P) and Royal Botanical Garden Edinburgh (E) were examined.

In addition to morphology, DNA sequences are extremely helpful in identifying families and genera, especially of sterile specimens (Toyama *et al.* 2013) and delimiting species (Hebert & Gregory 2005, Dick & Webb 2012). We sequenced two DNA barcode regions; the partial genes for the large subunit ribulose-1,5-bisphosphate carboxylase oxygenase (*rbcL*) and maturase K (*matK*) (CBOL Plant Working Group 2009) according to published protocols (Kress *et al.* 2009, Dunning & Savolainen 2010).

### **Garcinia bokorensis** H. Toyama & Yahara, **sp. nov.**— Figs. 2 & 3.

Similar to *G. fusca* Pierre, but distinguished by having 12–20 stamens in staminate flower (vs. stamens 50–60), smaller outer sepals, 2.3–2.5 mm long, 2–2.2 mm wide (vs. 3–6 mm long, 4–6 mm wide), smaller inner sepals, 2.8–3 mm long, 2.3–2.5 mm wide (vs. 5–7 mm long, 5–6 mm wide) and smaller petals, ca. 5 mm long, 2.5 mm wide (vs. 8 mm long, 5 mm wide).

*Typus.* CAMBODIA, Kampot Prov., Bokor National Park, evergreen forest, 10°37′15.48″ N, 104°05′10.71″ E, elevation. 888 m, 9 December 2011, *H. Toyama, S. Tagane, T. Ide, P. Chhang, H. Nagamasu & T. Yahara 1891* [fl.] (holotype–KYO; isotypes–FU, Forest Administration of Cambodia)

Trees, dioecious, evergreen, to 14 m tall; trunk longitudinally fissured, pale grayish brown or brown; latex yellow; twigs glabrous, twisted, green, tetragonous when young, turning reddish brown or dark-brown and terete in age; latex pale yellow. Leaves opposite; petiole (0.3–)0.6–0.9 cm long, adaxially sulcate, glabrous; blade glabrous, elliptic, ovate-oblong or obovate-oblong, (2–)4.5–9(–12) cm long, (0.6–)1.5–3(–3.7) cm wide, subcoriaceous, base attenuate, margin entire, apex acuminate; abaxial midrib prominent, adaxial midrib slightly prominent; lateral veins 15–20 pairs, faint on both surfaces when fresh, prominent and distinct on both surfaces when dry, joining the weak intramarginal vein, ca. 0.5 mm apart from the margin; tertiary venation obvious on both surfaces when dry. Inflorescence of staminate flowers axillary and terminal, fascicles of (1 or)2–6 flowers. Staminate flowers tetramerous; pedicel 4–10 mm long, glabrous; sepals elliptic or ovate-elliptic, greenish yellow, outer sepals 2.3–2.5 mm long, 2–2.2 mm wide, inner sepals 2.8–3 mm long, 2.3–2.5 mm wide; petals elliptic-oblong, ca. 5 mm long, 2.5 mm wide, apex rounded, thicker than sepals, cream; stamens 12–20, 0.7 mm long, 0.5 mm wide, 4-angled, connate into a subsessile hemispheric head; filaments subsessile; thecae of anthers separated at corners, longitudinally dehiscent, ca. 0.25 mm long; pistillode absent. Carpellate flowers not seen. Fruit solitary, smooth, subglobose, ca. 3 cm in diam., green when young, yellowish orange at maturity, sepals persistent at base, stigma persistent at apex, radially 5 or 6-lobed (not seen in good condition); pedicel 6–8 mm long. Seeds 2–4, ellipsoid, 14 mm long, 7 mm wide, 3 mm thick.

*Distribution*. Cambodia (only known from Bokor National Park).

*Additional specimens examined*. CAMBODIA, Kampot Prov., Bokor National Park, elevation. 1,014 m, 10°38′12.59″ N, 104°02′06.37″ E, 6 December 2011, *H. Toyama, S. Tagane, T. Kajisa, K. Mase, M. Nobayashi, N. Mihara, T. Ide, P. Chhang & H. Nagamasu 1685* (FU, Forest Administration of Cambodia); ibid., elevation. 917 m, 10°39′30.82″ N, 04°03′05.14″ E, 8 December 2011, *H. Toyama, S. Tagane, T. Ide, P. Chhang, H. Nagamasu & T. Yahara 1745* (FU, Forest Administration of Cambodia); ibid., elevation. 888 m, 10°37′15.48″ N, 104°05′10.71″ E, 9 December 2011, *H. Toyama, S. Tagane, T. Ide, P. Chhang, H. Nagamasu & T. Yahara 1828* (FU, Forest administration in Cambodia); ibid., elevation. 928 m, 10°39′19.53″ N, 104°03′36.61″ E, 10 May 2012, *H. Toyama, S. Tagane, T. Mishima, K. Tagawa, M. Zhang, P. Chhang, F. Iwanaga, H. Nagamasu & T. Yahara 2830* [fr.] (FU, Forest administration in Cambodia); ibid., elevation. 935 m, 10°39′09.06″ N, 104°03′38.68″ E, 17 July 2012, *S. Tagane, K. Fuse & P. Chhang 4029* [fr.] (FU, Forest administration in Cambodia); ibid., elevation. 1,001 m, 10°37′39.84″ N, 104°03′28.16″ E, 18 July 2012, *S. Tagane, K. Fuse & P. Chhang 4082* [fl.] (FU, K, P, Forest administration in Cambodia); ibid., elevation. 928 m, 10°39′19.53″ N, 104°03′36.61″ E, 8 August 2013, *S. Tagane, K. Fuse, S. Yokota, M. Zhang & P. Chhang 5770* [fr.] (FU, Forest administration in Cambodia).

*Habitat and ecology*. *Garcinia bokorensis* is common in moist dense evergreen forests on and near the top of the plateau at 888—1,014 m elevation. *Castanopsis acuminatissima* (Blume) A. DC., *Olea salicifolia* Wall. ex G. Don, *Nephelium hypoleucum* Kurz, *Dracaena gracilis* (Baker) Hook.f., *Baccaurea ramiflora* Lour. are dominant around 890 m. Around 925 m, *Ilex wallichii* Hook. f., *Ardisia sanguinolenta* Blume, *Rhaphiolepis indica* (L.) Lindl. ex Ker Gawl., *Rapanea neriifolia* (Siebold & Zucc.) Mez var. macrocarpa (Pit.) C. M. Hu, *Calophyllum tetrapterum* Miq. are dominant. At 1,014 m elevation., *Tristaniopsis merguensis* (Griff.) Peter G. Wilson & J. T. Waterh., *Rhaphiolepis mekongensis* (Cardot) Tagane & H. Toyama, *Lithocarpus elephantum* (Hance) A. Camus, *Macaranga andamanica* Kurz, *Antidesma acidum* Retz. are dominant. Flowers were observed in December and July, fruits were observed in May, July and August. Further observations are needed to determine the detailed phenology.

*Vernacular name*. Thromoung.

*Notes*. The leaves of *Garcinia bokorensis* are similar in shape to *G. bonii* Pitard, but the latter has circular anthers and is classified in sect. *Hebradendron* (Pitard 1910, Gagnepain 1943). A specimen similar to ours, collected in the same region by Poilane (mont de l'Éléphant, 1,000 m elevation., 6-8-1919, *Poilane* 223, P) and identified as *G. loureiroi* Pierre (a synonym of *G. cochinchinensis*), may be *G. bokorensis.*

*Genebank accession No. Toyama et al. 1685*, AB986034 (*rbcL*), AB986038 (*matK*); *Toyama et al. 1745*, AB986035 (*rbcL*), AB986039 (*matK*); *Toyama et al. 1828*, AB986036 (*rbcL*), AB986040 (*matK*); *Toyama et al. 1891*, AB986037 (*rbcL*), AB986041 (*matK*).

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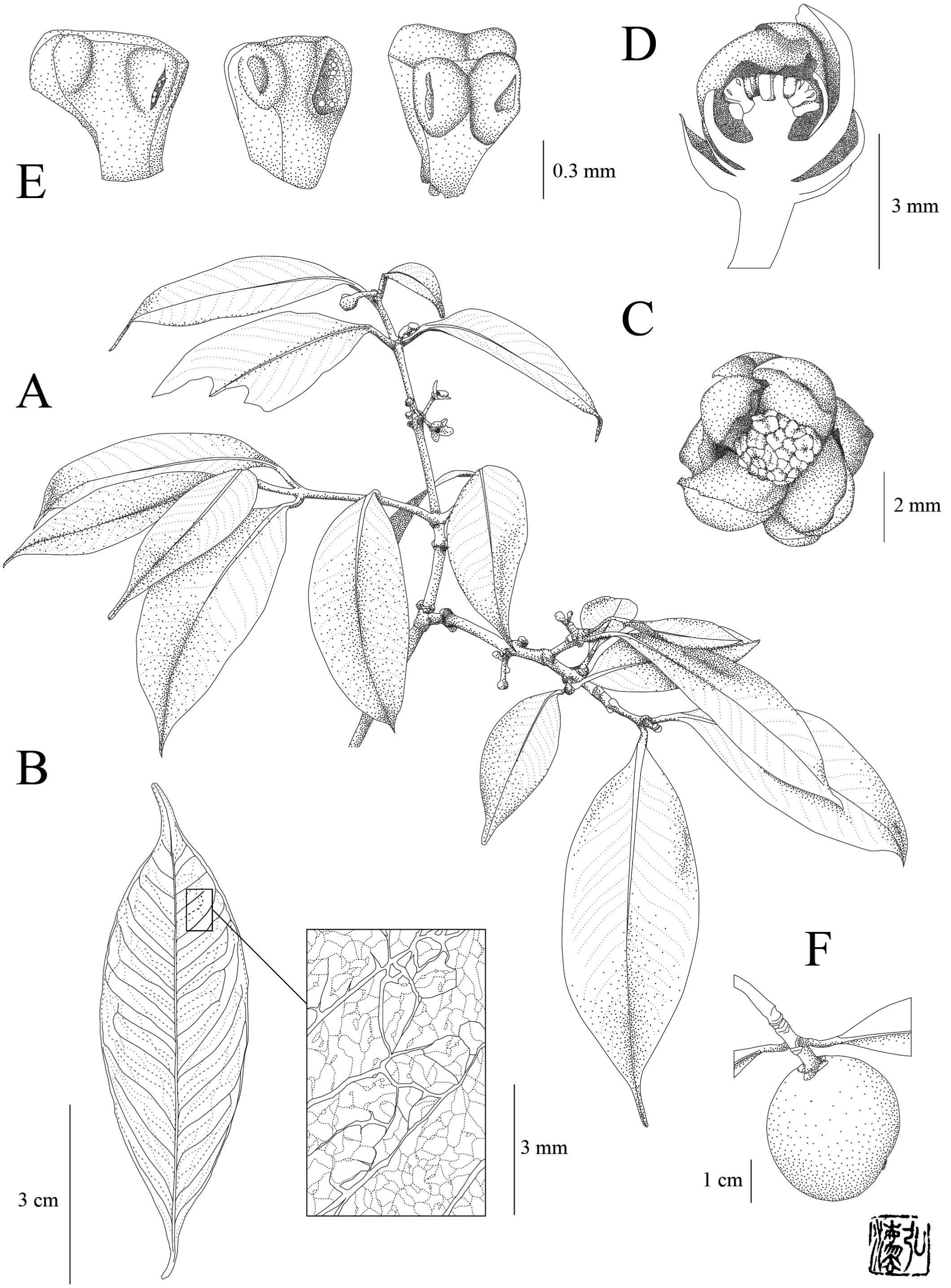

FIG. 2. *Garcinia bokorensis* H. Toyama & Yahara. A. Flowering twig; B. leaves (abaxial surface and magnification from left); C. staminate flower; D. longitudinal section of staminate flower; E. stamens; F. fruit (A from photograph taken on 9 December 2011; B, D & E from *Toyama et al. 1819*, FU & KYO; C from *Tagane et al. 4082*, FU; F from photograph taken on 17 July 2012. Drawn by H. Toyama).

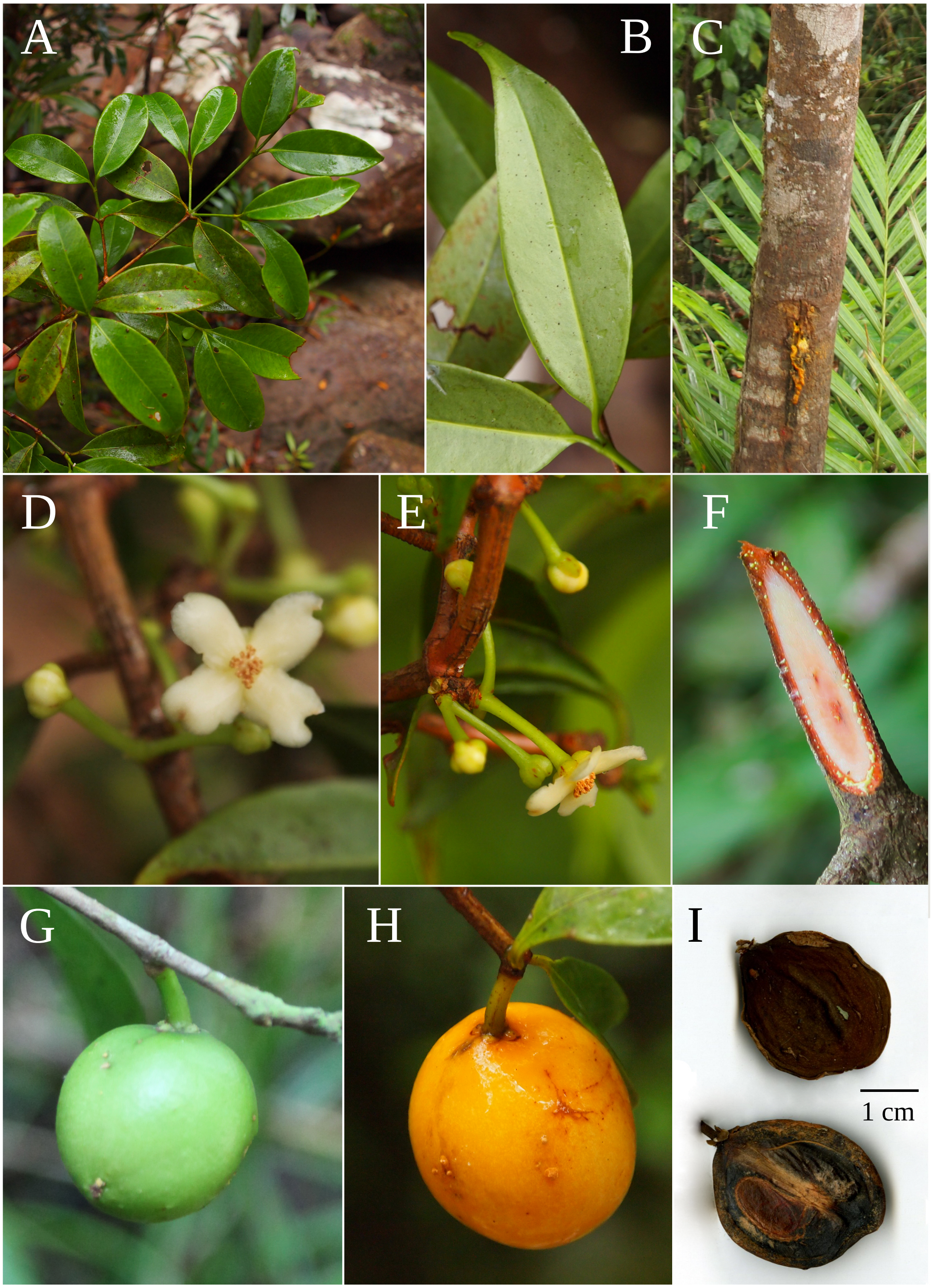

FIG. 3. *Garcinia bokorensis* H. Toyama & Yahara. A. habit; B. abaxial surface; C. trunk; D & E. staminate flowers; F, latex; G & H. fruit; I, longitudinal section of fruit (A & B photographed on 8 December 2012; C, D & E photographed on 18 July 2012; F photographed on 9 December 2011; G photographed on 10 May 2012; H photographed on 8 August 2013; I from *Toyama et al. 2830*, FU).

Key to species of *Garcinia* sect. *Oxycarpus* in Indochina

1a. Leaves papery ........................................ 2
1b. Leaves subcoriaceous or coriaceous ........................................ 3
2a. Stamens 40–50 in staminate flowers, 1–8 anthers per fascicle in carpellate flowers ................ *G. cowa*
2b. Stamens 70–105 in staminate flowers, 7–13 anthers per fascicle in carpellate flowers........................................ *G. cochinchinensis*
3a. Leaves 4–8 cm wide (rarely less than 4 cm) ........................................ 4
3b. Leaves 1.5–3 cm wide ........................................ 5
4a. Stamens about 65 in staminate flowers, 3–8 anthers par fascicle in carpellate flowers .... *G. delpyana*
4b. Stamens about 180 in staminate flowers, 13–26 anthers par fascicle in carpellate flowers .. *G. oliveri*
5a. Stamens 12–25 in staminate flowers ........................................ 6
5b. Stamens more than 30 in staminate flowers ........................................ 7
6a. Fruit faintly sulcate, oblong-globose with acuminate apex ........................................ *G. nigrolineata*
6b. Fruit smooth, subglobose with rounded apex ........................................ ***G. bokorensis***
7a. Ovary locules 8–10; stamens 30–35 in staminate flowers ........................................ *G. oblongifolia*
7b. Ovary locules 5–7; stamens 50–60 in staminate flowers ........................................ 8
8a. Ovary locules 5; fruit ovoid to oblong ........................................ *G. schomburgkiana*
8b. Ovary locules 7; fruit subglobose ........................................ *G. fusca*

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